How to Create Panoramic Images

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Why do Panoramas?

- A panoramic photograph has a wide format. The ratio between height and length of the photo is 1:2⁺. The field of view is greater than 100°, and frequently exceeds the angle of human vision (~140°).
- Why not do an iPhone Pano?
 - Less control of perspective (straight lines curve)
 - Only 72 dpi. Need more for large prints and good projectors.
 - JPEG: Raw format has more image information: much wider dynamic range and larger color space. Editing can push the images a lot further, bringing out and rescuing hidden detail in the darkest shadows and brightest highlights.
- Why not use a wide angle lens? (and crop)
 - Wide angle lens may not be wide enough
 - Undesirable lens distortion
 - With larger prints get more pixels from pano than in single shot.
 - Can use general purpose zoom lens

Wide Angle May Not Be Wide Enough:



12mm

Camera Equipment

- **Digital Camera** Need the exposure (aperture, shutter speed and ISO) to be locked so that all individual images match where they overlap. Ideally, want to shoot in full Manual mode (preferably a DSLR).
- Lens Zoom lenses are the most useful. Fixed/prime lenses work, but being able to zoom in and out will give you more versatility. Any midrange zoom lens such as a 24-70mm is great.
- Lens Filters Recommend taking filters off your lens. It is OK to keep a clear (e.g. UV) filter on, as long as it is not introducing any vignetting to your images on the wide end. Remove a circular polarizer if you have one mounted on your lens, because it will mess up your sky. E.g.:



Camera Equipment, con't

- **Tripod** optional, but highly recommended for best results. The head needs to be able to pan from left to right with ease.
- Arrange camera in Portrait orientation (requires camera L-bracket if using tripod).



- **Cable Release** optional, but recommended for capturing shake-free images. 2 sec shutter delay is good too.
- Panoramic Setup a full panoramic kit is ideal for best results, but it isn't as important when there are no foreground objects in panoramic image. More on this follows.

Settings

- Shoot in "Manual" mode
- ISO turn off "Auto ISO". Set to fixed value, e.g. camera base ISO (either 100 or 200) for sunny day.
- Aperture and Shutter Speed want everything in focus. Set aperture to preferably f/10+ (depending on nearest foreground object). Then set shutter speed based on the meter reading as explained below.
- Metering try to find a "sweet middle" and set your shutter speed based on entire panorama. Take a couple of pictures and make sure that the images are not too overexposed or underexposed for the brightest and darkest parts of the scene.
- Shoot in raw (optional) Lightroom Classic CC provides a raw pano, great for editing.
- White Balance set to "Sunny", "Cloudy", etc <u>not</u> "Auto WB".
- Lens Focal Length wide-angle lenses below 24-28mm (full-frame) and 16-18mm (APSC) can have heavy distortion and vignetting issues that can make it difficult to properly align and stitch images.
- Set your lens to Manual Focus
- If using tripod, turn lens Image Stabilization (IS) off. The IS motor will try to find camera motion, and will start to vibrate the tripod itself! Mirror slap when pressing the shutter can stimulate this IS behavior too.

Steps

• Take a Test Shot in "Aperture Priority" Mode

- First, to identify the correct exposure settings, switch to Aperture Priority mode, set the aperture to f/11, focus, then take a test shot of the brightest part of the scene.
- Check that the test shot has enough sharpness in the foreground and the background. If it doesn't, then increase your aperture value, e.g. to f/16, even f/20, adjust focus, and take another test shot.
- Double-check that there are no blown highlights in your test image. If you do find blown highlights adjust shutter speed or ISO until you get a good test shot.

Select "Manual Mode"

- Apply Aperture, Shutter Speed, and ISO settings
- Set White Balance to fixed value of "Sunny", "Cloudy", etc.
- Make sure that the focus is on manual and set properly.
 - Image Stabilization is off if using tripod.
- Cable Release plugged in to camera or shutter release delayed (e.g. 2 sec)

Steps, con't

- Start from the left side of the pano
- Take a shot and remember a spot in the image that is going to be the left edge of the 2nd image, providing for ~30% -50% overlap.



 Rotate camera to right and take 2nd shot, remembering a spot in the image that is going to be the left edge of the 3rd image ...

Example: Great Falls, Olmsted Island, MD

- Canon 5D Mark IV full-frame camera
- Canon 24-105mm f/4L lens at 43mm focal length
- Tripod & Ballhead no special pano gear
- Portrait orientation with camera L-bracket
- Manual Mode, f/20, 1/160 sec., ISO 400, WB: "Sunny"
- 8 shots, overlapped by ~30%

8 Overlapped Photos (Great Falls, MD)

















Apply Panorama Software

Photo Stitching Software to Create Panoramas

- Hugin
- Microsoft Image Composite Editor
- PTGui Pro
- AutoPano Pro
- Panorama Stitcher
- iFoto Stitcher
- Adobe Lightroom Classic CC
- Adobe Photoshop CC
- Lightroom Classic
- Me: Lightroom Classic CC:
 - In image folder select all images to be used in pano (all will turn light gray when selected)
 - Select Photo > Photo Merge > Panorama
 - Select a projection.
 - After preview is displayed, click on "Merge"

Open Image Folder

Lightroom Catalog - Adobe Photoshop Lightroom - Library

File Edit Library Photo Metadata View Window Help

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Select All (click on #1, Shift-click on #7): They turn light gray.



Lightroom Catalog - Adobe Photoshop Lightroom - Library



Click on

> Photo > Photo Merge > Panorama

Select "Cylindrical" or "Perspective"

Wait for preview ...





Click on Merge if it looks good

Lightroom: Selecting a Projection

- **Spherical**: Aligns and transforms the images as if they were mapped to the inside of a sphere. This projection mode is great for really wide or multirow panoramas.
- **Perspective**: Projects the panorama as if it were mapped to a flat surface. Since this mode **keeps straight lines straight**, it is great for architectural photography. Really wide panoramas may not work well due to excessive distortion near the edges of the resulting panorama.
- **Cylindrical**: Projects the panorama as if it were mapped to the inside of a cylinder. This projection mode works really well for wide panoramas, but it also keeps vertical lines straight. **(Selected in example)**



Post-processing: crop, clarity, vibrance



Lesson: Allow for extra vertical coverage when picking a focal length! Stitching and warping create gaps on top and bottom.

Example #2: Great Falls, Olmsted Island, MD

- Canon 5D Mark IV full-frame camera
- Canon 16-35mm f/2.8L lens at 16mm focal length
- Tripod & Ballhead no special pano gear
- Regular Landscape orientation
- Manual Mode, f/20, 1/160 sec., ISO 400, WB: "Sunny"
- 4 shots, overlapped by ~30%

16mm Wide Angle Pano

16-35mm Canon f/2.8 L at 16mm. Tripod. Manual Focus, "Sunny" WB. Manual Mode: f/20, 1/160 sec, ISO 400





16mm Landscape Pano - Final



Post-Processing: Cropped, Clarity, Vibrance

(could even use this lens in portrait orientation, also with lens correction, for more vertical coverage)

Example #3: Great Falls, Olmsted Island, MD

- Canon 5D Mark IV full-frame camera
- Canon 24-105mm f/4L lens at 43mm focal length
- Handheld tried to keep it as level as possible
- Portrait orientation
- Manual Mode, f/20, 1/160 sec., ISO 400, WB: "Sunny"
- 7 shots, overlapped by ~30%
 - Group of people on left avoided

Handheld Pano



Example #4: Great Falls, Olmsted Island, MD

- Canon 5D Mark IV full-frame camera
- Canon 24-105mm f/4L lens at 43mm focal length
- Handheld tried to keep it as level as possible
- Portrait orientation
- Manual Mode, f/20, 1/160 sec., ISO 400, WB: "Sunny"
- My buddy "Smiley" joined for his portrait.
- 7 shots, overlapped by ~30%
 - Group of people on left avoided

Handheld – Object in foreground

Foreground Smiley OK, but wooden bannister warped.



Lightroom – Pano with "Cylindrical" Projection

Handheld – Object in foreground

Straightens wooden bannister, but Smiley is upset.



Lightroom – Pano with "Perspective" Projection

Why is Smiley messed up?

- Camera parallax during rotation has moved foreground objects relative to their backgrounds differently between individual images.
- Stitching software having trouble identifying tie points between images.
- Shifting and warping isn't right.
- This can be prevented by rotating the camera about the middle of the lens rather than about the camera body when using a tripod, or worse yet: about your own torso when handheld.

When Rotate about Camera Body

Shoot image for left side of pano



Shoot image for right side of pano



Foreground statue has moved to the left against the background

"Nodal Point" is Offset from Camera



The Nodal Point is the optical center of the lens. It is the point that sets the camera's viewing angles of subjects. It can move with focal length changes.

Removing Parallax



Rotate Camera about Nodal Point





No change in foreground/background alignment

Compare Pano Stitching



Careless rotation yields alignment issues (or failure of stitching program)

Rotation about nodal point provides consistent image feature positions and success.

Panoramic Kit

https://www.bhphotovideo.com/explora/photography/tipsand-solutions/tools-of-the-trade-for-panoramic-photographers



acratech-for-accurate-panorama-photography/

http://www.reallyrightstuff.com/Single-Row-Pano-Kits



- Vertical blue line: axis of rotation
- Horizontal red line: lateral centerline of lens axis
- Diagonal yellow lines: light rays cross in the optical center of the lens

Finding the No-Parallax Setting

- Find two vertical objects; one near, one far. Position your equipment so that these objects line up in the viewfinder.
- Level your equipment.
- Mount and center your camera on the nodal slide.
- Select a focal length (you may wish to build a list for several focal lengths)
- Start out by positioning the approximate center of your lens over the axis of rotation.
- Now pan left.
- If the rear object appears to shift to the left, then you are ahead of the No-Parallax Point. Slide the nodal slide forward and try again.
- If the rear object appears to shift to the right, you are behind the No-Parallax Point. Slide the nodal slide back and try again.
- When the optical center of the lens is directly over the axis of rotation, the rear object will not appear to move relative to the front object.
- Record your results so that your setup can be re-created.





Nodal Slide Too Far Back



Nodal Slide Too Far Forward



Nodal Slide Just Right



Example #5: Great Falls, Olmsted Island, MD

- Canon 5D Mark IV full-frame camera
- Canon 24-105mm f/4L lens at 43mm focal length
- Tripod, Ballhead, Panning Clamp, and Nodal Slide
- Portrait orientation
- Manual Mode, f/20, 1/160 sec., ISO 400, WB: "Sunny"
- Calibrated the Nodal Slide to 102 mm to eliminate parallax at 43mm focal length
- 7 shots, overlapped by ~30%
 - Group of people on left avoided
- Lightroom Panorama with Perspective projection.
 - Cropped, Clarity, Vibrance Adjustments

The End

